

F04B

POSITIVE DISPLACEMENT MACHINES FOR LIQUIDS; PUMPS (machines for liquids, or pumps, of rotary piston or oscillating piston type [F04C](#); non-positive displacement pumps [F04D](#); pumping of fluid by direct contact of another fluid or by using inertia of fluid to be pumped [F04F](#); crankshafts, crossheads, connecting-rods [F16C](#); flywheels [F16F](#); gearings for interconverting rotary motion and reciprocating motion in general [F16H](#); pistons, piston-rods, cylinders, in general [F16J](#))

Definition statement

This place covers:

Pumps or compressors which cause a fluid to move by trapping a fixed amount of said fluid, and then forcing or displacing the trapped fluid into discharge means.

Reciprocating pumps or compressors causing the fluid to move using one or more oscillating pistons, plungers or flexible working members, i.e. membranes, diaphragms or tubes.

Relationships with other classification places

Related subclasses [F02M](#), [F02B](#) and [F03C](#) partly cover the same type of structural apparatus using reciprocating or oscillating pistons or flexible working members for positive displacement.

The characteristic used for distinguishing the types of machines is the working fluid used, i.e. a liquid for a pump and an elastic fluid for a compressor.

If the machine may be operated with a liquid as a working fluid both as a hydraulic engine and/or as a pump, then the document is classified in [F03C](#) and in [F04B](#). However, if the machine may be operated only as a hydraulic motor, then the document is classified in [F03C](#), and if the machine may be operated only as a pump, then the document is classified in [F04B](#).

Hydraulic motors with reciprocating or rotary pistons for liquid working fluids are classified in [F03C](#). Machines with reciprocating or rotary pistons for working fluids containing elastic fluids, e.g. a combination of liquids and elastic fluids are classified in [F01C](#). Internal combustion piston engines or combustion engines in general, where the driving forces are generated by expansion of gases due to combustion are classified in [F02B](#).

Subject matter like cyclically operating valves, lubricating or cooling are classified in subclasses [F01L](#), [F01M](#), [F01P](#) irrespective of their stated application, unless their novel and non-obvious features are peculiar to their application, in which case they are classified only in the relevant subclass of [F04](#). The subclasses [F01L](#), [F01M](#), [F01P](#) do not cover pump or machine features per se.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Rotary-piston or oscillating piston machines for elastic fluids	F01C
Cyclically operating valves for machines or engines	F01L
Lubrication of machines or engines in general	F01M
Cooling of machines or engines in general	F01P
Internal combustion piston engines or combustion engines in general	F02B
Fuel injection apparatus	F02M 39/00 - F02M 57/00
Positive-displacement engines driven by liquids	F03C

Rotary-piston or oscillating piston machines	F04C
Non-positive displacement pumps	F04D
Crankshafts, crossheads, connecting-rods	F16C
Flywheels	F16F
Rotary fluid gearing using pumps and motors of the volumetric type for conveying rotary motion	F16H
Sealing in general	F16J
Means for thermal insulation in general	F16L
Refrigeration machines, plants or systems	F25B
Dynamo electric machines	H02K

Special rules of classification

Reciprocating piston type:

Documents indicating that the machine may be operated both as a hydraulic engine and/or as a pump are classified in [F03C](#) and in [F04B](#).

In cases where pump/compressor control or control parameters thereof are of special interest, the document should be classified by using the corresponding Indexing Code of [F04B](#).

In cases where a specific liquid handled by the pump is of special interest, the document should be classified by using the corresponding Indexing Code of [F04B 15/00](#).

In cases where a material or material properties are of special interest, the document should be classified by using the corresponding Indexing Code of [F05C](#).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Pump	Device for continuously raising, forcing, compressing, or exhausting fluid by mechanical means
Machine	Device that could equally be both an engine and a pump and not a device which is restricted to an engine or one which is restricted to a pump
Positive displacement pumps	Pumps using pistons or other mechanical members to displace a working fluid in a working chamber, the dynamic effect on the fluid being of minor importance
Positive displacement engines	The energy of a working fluid is transformed into mechanical energy, in which variations of volume created by the working fluid in a working chamber produce equivalent movement of mechanical members, e.g. pistons transmitting the energy, the dynamic effect of the fluid being of minor importance
Oscillating piston machine	Positive-displacement machine in which a fluid-engaging, work-transmitting member oscillates, e.g. a vane piston swinging back and forth about a fixed axis
Reciprocating piston	A fluid-engaging, work-transmitting member of a reciprocating-piston type machine or pump that slides alternately back and forth usually along a straight line or path

Rotary piston	A fluid engaging, work-transmitting member of a rotary-piston machine or pump that can completely rotate about a fixed axis or about an axis moving along a circular or similar orbit when operating, e.g. rotor having vanes or teeth
Free-piston machine	A linear, "crankless" reciprocating piston machine in which the piston motion is not controlled by a crankshaft but determined by the interaction forces from the fluid pressure in the working chamber, a rebound device (e.g. a piston in a closed cylinder) and a load device (e.g. a gas compressor or a linear alternator)
Rotary piston machine	Positive-displacement machine in which a liquid-engaging, work-transmitting member rotates about a fixed axis or about an axis moving along a circular or similar orbit, e.g. machine with a rotor having vanes or teeth
Cooperating members	The "oscillating piston" or "rotary piston" and another member, e.g., the working-chamber wall, which assists in the pumping action or machine's action
Movement of the cooperating members	To be interpreted as relative, so that one of the "cooperating members" may be stationary, even though reference may be made to its rotational axis, or both may move
Teeth or tooth equivalents	Includes lobes, projections or abutments
Internal axis type	The rotational axes of the inner and outer co-operating members remain at all times within the outer member, e.g., in a similar manner to that of a pinion meshing with the internal teeth of a ring gear
Working fluid	Driven fluid in a pump or driving or driven liquid in a machine. The working fluid can be in a compressible, gaseous state, e.g. steam, called elastic fluid, a liquid state, or a state where there is coexistence of elastic fluid and liquid state

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "piston" and "plunger";
- "membrane" and "diaphragm".

F04B 1/00

Multi-cylinder machines or pumps characterised by number or arrangements of cylinders (F04B 3/00 takes precedence; fluid-driven pumps F04B 9/08; control of reciprocating machines or pumps in general F04B 49/00)

Definition statement

This place covers:

Pumps for liquids defined by the number of cylinders (e.g. having two or more cylinders) or by the arrangement of the cylinders (e.g. radial piston pumps with cylinders in star or fan arrangement, or axial piston pumps with cylinders parallel or inclined with respect to a main shaft).

References

Limiting references

This place does not cover:

Compressors, i.e. pumps for elastic fluids	F04B 27/00
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Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Reciprocating-piston engines	F03C 1/00
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Special rules of classification

If a document concerns embodiments which are covered by several subgroups dependent on a higher hierarchy head group, e.g. valve types [F04B 1/0452](#), the following classification rules apply:- the specific technical information relevant for some of the subgroups is classified in all of said subgroups;- if generic technical information common to all of the subgroups is disclosed and only schematic embodiments are represented, then the document is classified in the higher hierarchy head group.

F04B 3/00

Machines or pumps with pistons coacting within one cylinder, e.g. multi-stage

Definition statement

This place covers:

Pumps for liquids, wherein two or more pistons reciprocate within one cylinder, or wherein one piston forms the cylinder of a further piston.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 5/00

Machines or pumps with differential surface pistons

Definition statement

This place covers:

Pumps for liquids, with stepped pistons or with double-acting pistons.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 7/00

Piston machines or pumps characterised by having positively-driven valving (with cylinders in star- or fan-arrangement [F04B 1/04](#); with cylinder axes coaxial with, or parallel or inclined to, main shaft axis [F04B 1/12](#))

Definition statement

This place covers:

Valves and distribution members being mounted in or adapted for pumps, wherein the valves are mechanically driven, actuated by electro-magnetic means, fluid actuated, or by reciprocating pistons.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 9/00

Piston machines or pumps characterised by the driving or driven means to or from their working members

Definition statement

This place covers:

Pumps for liquids driven by mechanical means, e.g. cams, eccentrics or other means or by fluid means, e.g. hydraulically driven or pneumatically driven. In this group are also classified pumps being manually driven by a user.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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Special rules of classification

If a document concerns embodiments which are covered by several subgroups dependent on a higher hierarchy head group, e.g. mechanical means [F04B 9/02](#), the following classification rules apply:- the specific technical information relevant for some of the subgroups is classified in all of said subgroups;- if generic technical information common to all of the subgroups is disclosed and only schematic embodiments are represented, then the document is classified in the higher hierarchy head group.

F04B 11/00**Equalisation of pulses, e.g. by use of air vessels; Counteracting cavitation****Definition statement**

This place covers:

Pumps for liquids comprising means for preventing problems occurring with pulsation, vibration and/or cavitation.

References**Application-oriented references**

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 13/00**Pumps specially modified to deliver fixed or variable measured quantities (for transferring liquid from bulk storage containers or reservoirs into vehicles or into portable containers [B67D 7/58](#))****Definition statement**

This place covers:

Pumps for liquids specially adapted for dosing purposes or for mixing two or more fluids.

References**Application-oriented references**

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 15/00**Pumps adapted to handle specific fluids, e.g. by selection of specific materials for pumps or pump parts****Definition statement**

This place covers:

Pumps specially adapted for pumping e.g. viscous fluids, fluids at high temperatures, corrosive fluids or cryogenic fluids.

Various types of pumps for liquids and for elastic fluids not provided for in other groups, e.g. pumps for corrosive fluids or for cryogenic fluids.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 17/00

Pumps characterised by combination with, or adaptation to, specific driving engines or motors

Definition statement

This place covers:

Pumps for liquids driven by specific engines or other driving means, such as e.g. electric motors, piezo-electric means, solar means, wind energy, or combustion engines. In this group are also classified mobile pumping systems, e.g. pumps on vehicles.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 19/00

Machines or pumps having pertinent characteristics not provided for in, or of interest apart from, groups [F04B 1/00](#) - [F04B 17/00](#)

Definition statement

This place covers:

In this group are classified various types of pumps not provided for in other groups, such as e.g. free-piston pumps, micropumps, pumps with movable cylinders, pumps for storage containers, scoop devices adhesion type pumps, or pumps using the effect of heat expansion.

References

Limiting references

This place does not cover:

Micropumps having plate-like flexible members.	F04B 43/043
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Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 23/00**Pumping installations or systems ([F04B 17/00](#) takes precedence)****Definition statement***This place covers:*

Pumps for liquids combined with reservoirs or with other fluid pumps.

References**Application-oriented references***Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:*

For raising fluid from great depths	F04B 47/00
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F04B 25/00**Multi-stage pumps****Definition statement***This place covers:*

Pumps for elastic fluids, e.g. gas or steam, having more than one pumping stage, e.g. with two or more cylinders or with stepped pistons.

References**Application-oriented references***Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:*

For raising fluid from great depths	F04B 47/00
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F04B 27/00**Multi-cylinder pumps characterised by number or arrangement of cylinders ([F04B 25/00](#) takes precedence; control of reciprocating machines or pumps in general [F04B 49/00](#))****Definition statement***This place covers:*

Pumps for elastic fluids, e.g. gas or steam, defined by the number of cylinders, e.g. having two or more cylinders, or by the arrangement of the cylinders, e.g. radial piston pumps with cylinders in star or fan arrangement, or axial piston pumps with cylinders parallel or inclined with respect to a main shaft.

Details relating to control systems and methods for pumps for elastic fluids, e.g. gas or steam, defined by having cylinders coaxial with, or parallel or inclined to, main shaft axis.

References

Limiting references

This place does not cover:

Pumps for liquids	F04B 1/00
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Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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Special rules of classification

If a document concerns embodiments which are covered by several subgroups dependent on a higher hierarchy head group, e.g. valve types classified in [F04B 27/0451](#); crankcase pressure control classified in [F04B 27/1804](#), the following classification rules apply:- the specific technical information relevant for some of the subgroups is classified in all of said subgroups;- if generic technical information common to all of the subgroups is disclosed and only schematic embodiments are represented, then the document is classified in the higher hierarchy head group.

F04B 29/00

{Other pumps with movable, e.g. rotatable cylinders}

Definition statement

This place covers:

Pumps for elastic fluids, e.g. gas or steam, being characterised by rotatable cylinders.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 31/00

Free-piston pumps; Systems incorporating such pumps (muscle-driven pumps in which the stroke is not defined by gearing [F04B 33/00](#); free-piston combustion engines, free-piston gas generators [F02B 71/00](#); systems predominated by prime mover aspects, see the relevant classes for the prime mover)

Definition statement

This place covers:

Pumps for elastic fluids, e.g. gas or steam, being of free-piston type.

References

Limiting references

This place does not cover:

Free-piston pumps for liquids	F04B 19/003
Free-piston engines.	F03C 99/005

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 33/00

Pumps actuated by muscle power, e.g. for inflating

Definition statement

This place covers:

Pumps for elastic fluids specially adapted for manual operation and for inflating tyres.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Arrangements of tyre-inflating valves to tyres or rims	B60C 29/00
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F04B 35/00

Piston pumps characterised by the driving means to their working members, or by combination with, or adaptation to, specific driving engines or motors, not otherwise provided for (predominant aspects of the engines or motors, see the relevant classes)

Definition statement

This place covers:

Pumps for elastic fluids, e.g. gas or steam, driven by specific engines or other driving means, such as e.g. electric motors, floating elements, steam engines, or combustion engines; Mobile pumping systems, e.g. compressors on vehicles.

F04B 37/00

Pumps having pertinent characteristics not provided for in, or of interest apart from, groups [F04B 25/00](#) - [F04B 35/00](#)

Definition statement

This place covers:

Various types of pumps for elastic fluids, e.g. gas or steam, not provided for in other groups, such as e.g. vacuum pumps evacuating by absorption means, vacuum pumps evacuating by thermal means, pumps for very high or very low pressure, or pumps for wet gases.

References**Application-oriented references**

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 39/00

Component parts, details, or accessories, of pumps or pumping systems, not otherwise provided for in, or of interest apart from, groups [F04B 25/00](#) - [F04B 37/00](#) (for controlling [F04B 49/00](#))

Definition statement

This place covers:

Various components adapted for pumps for elastic fluids, e.g. gas or steam, such as e.g. piston means, pulsation damping means, lubrication means, cooling means, filtering means, compressor valves, compressor casings.

References**Application-oriented references**

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 39/02

Lubrication (of machines or engines in general [F01M](#))

Definition statement

This place covers:

Lubrication of pumps for liquids and elastic fluids.

F04B 41/00

Pumping installations or systems ([F04B 31/00](#), [F04B 35/00](#) take precedence)

Definition statement

This place covers:

Pumps for elastic fluids, e.g. gas or steam, combined with reservoirs or with other fluid pumps.

References**Application-oriented references**

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

For raising fluid from great depths	F04B 47/00
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F04B 43/00

Machines, pumps, or pumping installations having flexible working members (pumps or pumping installations specially adapted for elastic fluids [F04B 45/00](#))

Definition statement

This place covers:

Pumps for liquids and for elastic fluids having flexible working members, such as diaphragms, tubular flexible members or pumps with peristaltic action; Micropumps having flexible working members.

F04B 45/00

Pumps or pumping installations having flexible working members and specially adapted for elastic fluids

Definition statement

This place covers:

Pumps having flexible working members and which are specifically adapted for elastic fluids. The flexible working members may be bellows, diaphragms or tubular flexible members.

F04B 47/00

Pumps or pumping installations specially adapted for raising fluids from great depths, e.g. well pumps (by using positive or negative pressurised fluid medium acting directly on the liquid to be pumped [F04F 1/00](#))

Definition statement

This place covers:

Pumps specifically adapted for raising fluids from great depths, such as wellbore pumps.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Methods or apparatus for obtaining oil, gas, water, soluble or meltable materials or a slurry of minerals from wells	E21B 43/00
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F04B 49/00

Control {, e.g. of pump delivery, or pump pressure} of, or safety measures for, machines, pumps, or pumping installations, not otherwise provided for, or of interest apart from, groups [F04B 1/00](#) - [F04B 47/00](#)

Definition statement

This place covers:

Control systems and methods for pumps for liquids and for elastic fluids.

Special rules of classification

If a document concerns embodiments which are covered by several subgroups dependent on a higher hierarchy head group, e.g. variable length of piston stroke classified in [F04B 49/12](#), the following classification rules apply:- the specific technical information relevant for some of the subgroups is classified in all of said subgroups;- if generic technical information common to all of the subgroups is disclosed and only schematic embodiments are represented, then the document is classified in the higher hierarchy head group.

F04B 51/00

Testing machines, pumps, or pumping installations

Definition statement

This place covers:

Systems and methods for testing pumps for liquids and for elastic fluids.

F04B 53/00

Component parts, details or accessories not provided for in, or of interest apart from, groups [F04B 1/00](#) - [F04B 23/00](#) or [F04B 39/00](#) - [F04B 47/00](#)

Definition statement

This place covers:

In this group are classified various components adapted for pumps for liquids and for elastic fluids, e.g. piston means, pulsation and noise damping means, lubrication means, cooling means, filtering means, compressor valves, housings or casings.

F04B 2201/00

Pump parameters

Definition statement

This place covers:

Pump control parameters for pumps for liquids and elastic fluids.

F04B 2203/00

Motor parameters

Definition statement

This place covers:

Motor control parameters of pumps for liquids and elastic fluids.

F04B 2205/00

Fluid parameters

Definition statement

This place covers:

Fluid parameters relating to pumps for liquids and elastic fluids.

F04B 2207/00

External parameters

Definition statement

This place covers:

External parameters relating to pumps for liquids and elastic fluids.